FRAMATOME ANP

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Potential Non-Conservative Modeling in Approved Appendix K Evaluation Models

Ref.: 1. Letter, NRC (S. Dembek) to Framatome ANP (James F. Mallay), "Potential Non-Conservative Modeling of Downcomer Boiling in the Approved Framatome ANP Emergency Core Cooling System Evaluation Model for Application to Certain Westinghouse and Combustion Engineering Designed Pressurized Water Reactors," June 3, 2002.

The NRC expressed a concern about a potential non-conservatism in a specific portion of Framatome ANP's approved ECCS evaluation model (Reference 1). Specifically, the NRC questioned the adequacy of the modeling of the downcomer region in the reactor vessel and whether boiling in this region might have an adverse effect on the peak cladding temperature and oxidation for certain sub-atmospheric containments, including ice condenser designs. Framatome ANP believes its current evaluation models comply with the pertinent regulations on ECCS analysis and are acceptable for continued use in licensee applications.

As a result of the NRC's inquiry, Framatome has initiated an extensive evaluation of the potential for boiling in the downcomer region to affect the results of its ECCS analyses relative to the pertinent regulatory acceptance criteria. This evaluation includes consideration of the generic effects for all PWR plant design types and for specific applications (sub-atmospheric and ice condenser designs) for which Framatome performs ECCS analysis. Our final response to the NRC's inquiry will depend on the results of this evaluation. This letter outlines Framatome's position based on the limited knowledge available today.

Framatome notes the following facts concerning the matter of potential downcomer boiling:

- Framatome is not familiar with any NRC-approved Appendix K evaluation model that models the downcomer during the reflood stage of a large break LOCA in sufficient detail to simulate boiling. In the absence of such a model, it is not possible to perform sensitivity studies on downcomer behavior, as suggested in Reference 1.

- Downcomer boiling will be enhanced with decreased containment pressure. The net effect of downcomer boiling is to increase the core bypass and to increase the amount of water lost out the break. Appendix K includes a specific conservatism that addresses ECCS bypass by requiring that all ECCS water remaining in the core at the end of blowdown be discarded. The origin of this requirement was the uncertainty about the amount of ECCS water that is actually lost out the break, regardless of the timing of this

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phenomenon. Adding a specific requirement to address one part of this ECCS bypass, namely downcomer boiling, is effectively double accounting and is unnecessary to provide an adequate level of safety.

- No part of the NRC regulations (or its supplemental regulatory guidance) addresses the matter of downcomer modeling or downcomer behavior. The original criteria contained in 10 CFR 50.46 and Appendix K were based on assumptions that clearly provided significant conservatisms to account for uncertainties and unidentified phenomena. Specifically, Framatome believes that the potential effect of downcomer boiling is more than compensated for by these intentional conservatisms to the extent that this particular phenomenon should not have to be accounted for in Appendix K evaluation models. On the other hand, realistic and best estimate models should include sufficient detail to address downcomer noding and the associated fluid behavior.

Information concerning the phenomenon of downcomer boiling is very limited, and published documents by the NRC consist of two internal memos. One memo is from S.M. Bajorek to J.E. Rosenthal of May 22, 2002. This same information is summarized in Attachment 4 to another memo from A.C. Thadani to S.J. Collins of June 20, 2002. The former memo relies on the analytical results contained in the FSAR for the Watts Bar nuclear power plant using a best estimate model. Information about this model and its application to Watts Bar are not available to Framatome to evaluate. Based on our own evaluations, however, these results from Watts Bar appear to reflect modeling difficulties or inaccuracies and do not fairly represent the limited effect that downcomer boiling is expected to have on peak cladding temperature. Downcomer boiling is expected to have its primary effect on cladding temperature behavior following the initial peak and may or may not create a second peak as high or higher than the first.

The first NRC memo reviews available experimental information, but these experiments do not support the PCT impact shown by the Watts Bar case. This lack of experimental validation may be due to inadequacies in the experiments or how they were instrumented, or it may reflect the limited or null effect this phenomenon has on cladding temperature.

Returning to the matter of the overall conservatism of Appendix K evaluation models, the following quote is taken from the end of the first internal memo cited above:

> *The findings discussed in this report are not meant to imply that calculations made using Appendix K Evaluation Models underestimate the peak cladding temperature (PCT) or equivalent clad reacted (ECR) in a large break LOCA. Appendix K requires the use of the 1971 ANS decay heat standard, which is known to be very conservative. Appendix K also requires several other conservative modeling assumptions. The conservatism associated with the 1971 decay heat model and these other Appendix K requirements* ***sufficiently compensates*** *for the downcomer boiling effect.* [Bolding added.]

Framatome ANP is committed to evaluating this recently-identified phenomenon of downcomer boiling to ensure our evaluation models are appropriately conservative. Framatome's continued commitment and interest is to ensure the safety of the plants for

which it performs safety analyses. We anticipate being able to make a more definitive statement on the matter by December 15, 2002.

Very truly yours,

James F. Mallay/kah

James F. Mallay, Director
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cc: D.G. Holland
Project 693